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Amendments t the Claims

Please amend claims 1, 31, and 76 and cancel claims 27, 54, and 75 without prejudice, as indicated herein. This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims

1. (Currently amended) An optical information recording medium comprising a substrate and a multilayer film, the multilayer film comprising:

a barrier layer;

a first protective layer that comprises sulfur; and

a recording layer generating a reversible phase-change which can be optically detected according to an irradiation of an energy beam;

wherein said barrier layer is formed between said first protective layer and said recording layer and in contact with said first protective layer and said recording layer, and includes one selected from the group consisting of GeXN and GeXNO, where X is at least one element selected from the group consisting of Al, B, Ba, Bi, C, Ca, Ce, Cr, Dy, Eu, Ga, Hf, In, K, La, Mn, Nb, Ni, Pb, Pd, ~~Si~~, Sn, Ta, Ti, V, W, Yb, Zn, and Zr, and

wherein the content of X to the total content of Ge and X in said barrier layer is 10 to 40 atom %, and the content of N in said barrier layer is 40 atom % or more.

2. (Original) The optical information recording medium according to claim 1, further comprising a second protective layer disposed at a side of said recording layer opposite to said barrier layer.

3. (Original) The optical information recording medium according to claim 2, wherein said first protective layer and said second protective layer include a first barrier material and a second barrier material, respectively, said first and second barrier materials are represented by M_aX_b (where M denotes either one of a single non-gas element and a compound of a plurality of different non-gas elements, and X denotes either one of a single gas element and a compound of a plurality of different gas elements), and a value b/(a+b) of either one of said first and second

barrier materials disposed at an energy beam-incident side of said recording layer is equal to or larger than the value of the other of said first and second barrier materials disposed at the side opposite to the energy beam-incident side.

4. (Original) The optical information recording medium according to claim 1, further comprising a reflecting layer disposed at the side of said recording layer opposite to an energy beam-incident side of said recording layer.

5. (Original) The optical information recording medium according to claim 4, further comprising a second protective layer disposed adjacent said recording layer, wherein said second protective layer is disposed between said reflecting layer and said recording layer, and has a thickness of 60 nm or less.

6. (Original) The optical information recording medium according to claim 5, wherein said barrier layer is disposed at the energy beam-incident side of said recording layer.

7. (Original) The optical information recording medium according to claim 1, wherein said first protective layer has a thickness of 80 nm or more.

8. (Cancelled)

9. (Original) The optical information recording medium according to claim 3, wherein each of said first and second barrier materials is either one selected from the group consisting of a nitride of a non-gas element and an oxynitride of a non-gas element.

10. (Cancelled)

11. (Original) The optical information recording medium according to claim 9, wherein said non-gas element comprises a non-gas element selected from the group consisting of Ge, Sb, Si Zr, Ti and Al.

12. (Original) The optical information recording medium according to claim 1, wherein said barrier layer includes a barrier material in which at least one selected from the group consisting of nitrogen and oxygen is less than a stoichiometric composition.

13. (Original) The optical information recording medium according to claim 1, wherein said barrier layer contains at least one element selected from the group consisting of Cr and Al and a density of said element is equal to or less than a density of a non-gas element in said barrier layer.

14. (Original) The optical information recording medium according to claim 1, further comprising: a second protective layer disposed at a side of said recording layer opposite to said barrier layer; wherein each of said first and second protective layers includes Ge, said recording layer is formed between said first and second protective layers, and a Ge density in either one of said first and second protective layers disposed at an energy beam-incident side of said recording layer is equal to or less than a Ge density in the other of said first and second protective layers disposed opposite to the energy beam-incident side of said recording layer.

15. (Original) The optical information recording medium according to claim 1, wherein said barrier layer includes Ge and a density of the Ge is in the range between 35 % and 90 %.

16. (Original) The optical information recording medium according to claim 1, wherein said barrier layer is disposed at an energy beam-incident side of said recording layer and includes Ge, and a Ge density of said barrier layer is in the range between 35 % and 60 %.

17. (Original) The optical information recording medium according to claim 1, wherein said barrier layer is disposed at a side opposite to an energy beam-incident side of said recording layer and includes Ge, and a Ge density of said barrier layer is in the range between 40 % and 90 %.

18. (Original) The optical information recording medium according to claim 1, wherein said barrier layer is disposed at a side opposite to an energy beam-incident side of said recording

layer and includes Ge, and a Ge density of said barrier layer is in the range between 40 % and 65 %.

19. (Original) The optical information recording medium according to claim 2, wherein said first protective layer and said second protective layer include a first barrier material and a second barrier material, respectively, and a composition of each of said first and second barrier materials is one composition existing within a region surrounded by four composition points $B1(Ge_{90.0}N_{10.0})$, $B4(Ge_{83.4}N_{3.3}O_{13.3})$, $G1(Ge_{35.0}N_{65.0})$, $G4(Ge_{31.1}N_{13.8}O_{55.1})$ in a three element composition diagram whose vertices are Ge, N, and O.

20. (Original) The optical information recording medium according to claim 19, wherein a composition of either one of said first and second barrier materials in a layer disposed at the energy beam-incident side of said recording layer is one composition existing within a region surrounded by four composition points $D1(Ge_{60.0}N_{40.0})$, $D4(Ge_{48.8}N_{10.2}O_{41.0})$, $G1(Ge_{35.0}N_{65.0})$, $G4(Ge_{31.1}N_{13.8}O_{55.1})$ in a three element composition diagram whose vertices are Ge, N, and O.

21. (Original) The optical information recording medium according to claim 19, wherein a composition of either one of said first and second barrier materials in a layer disposed at the side opposite to the energy beam-incident side of said recording layer is one composition existing within a region surrounded by four composition points $B1(Ge_{90.0}N_{10.0})$, $B4(Ge_{83.4}N_{3.3}O_{13.3})$, $F1(Ge_{42.9}N_{57.1})$, $F4(Ge_{35.5}N_{12.9}O_{51.6})$ in a three element composition diagram whose vertices are Ge, N, and O.

22. (Original) The optical information recording medium according to claim 21, wherein said composition is one composition existing within a region surrounded by four composition points $C1(Ge_{65.0}N_{35.0})$, $C4(Ge_{53.9}N_{9.2}O_{36.9})$, $F1(Ge_{42.9}N_{57.1})$, $F4(Ge_{35.5}N_{12.9}O_{51.6})$ in a three element composition diagram whose vertices are Ge, N, and O.

23. (Original) The optical information recording medium according to claim 1, wherein a value n and a value k included in a complex refractive index $n + ik$ of a barrier material of said barrier layer are within the range of $1.7 \leq n \leq 3.8$ and $0 \leq k \leq 0.8$, respectively.

24. (Original) The optical information recording medium according to claim 23, wherein the value n and the value k included in the complex refractive index (n + ik) of said barrier material are within the range of $1.7 \leq n \leq 2.8$ and $0 \leq k \leq 0.3$, respectively.

25. (Original) The optical information recording medium according to claim 1, wherein said recording layer includes a phase-change material containing at least one of Te, Sb and Se.

26. (Original) The optical information recording medium according to claim 25, wherein said phase-change material contains Ge-Sb-Te.

27 - 28. (Cancelled)

29. (Original) A method of recording/erasing/reproducing an optical information by recording, reproducing, and erasing an optical information on the optical information recording medium as in claim 1 by irradiating a laser beam with controlling power of the laser beam.

30. (Cancelled)

31. (Currently amended) A method of recording/erasing/reproducing optical information, comprising the steps of:

providing an optical information recording medium comprising a substrate and a multilayer film, the multilayer film comprising a recording layer generating a reversible phase-change which can be optically detected according to an irradiation of an energy beam, a barrier layer, and a protective layer that comprises sulfur;

recording a signal to said recording layer by irradiating said recording layer with a modulated laser beam erasing a signal recorded on said recording layer by irradiating said recording layer with a laser beam having a predetermined power level;

reproducing a signal recorded on said recording layer by irradiating a laser beam to said recording layer and detecting a light strength of a reflection light or a transmitted light from said recording layer;

wherein said barrier layer is formed between said protective layer and said recording layer and in contact with said protective layer and said recording layer, and includes one selected from the group consisting of GeXn and GeXNO, where X is at least one element selected from the group consisting of Al, B, Ba, Bi, C, Ca, Ce, Cr, Dy, Eu, Ga, Hf, In, K, La, Mn, Nb, Ni, Pb, Pd, Si, Sn, Ta, Ti V, W, Yb, Zn, and Zr, and

wherein the content of X to the total content of Ge and X is said barrier layer is 10 atom % to 40 atom %, and the content of N in said barrier layer is at least 40 atom %.

32 - 49. (Cancelled)

50. (Previously presented) An optical information recording medium comprising a substrate and a multilayer film, the multilayer film comprising phase-change recording layer having reversibly changeable optical characteristics and a Ge-containing layer comprising one selected from the group consisting of GeXN and GeXON as a main component, and a protective layer comprising sulfur, wherein the Ge-containing layer is formed between the phase-change recording layer and the protective layer,

wherein X is at least one element selected from the group consisting of elements belonging to Groups IIIa, IVa, Va, VIa, VIIa, VIII, Ib and IIb and carbon, and

wherein the content of X to the total content of Ge and X in said Ge-containing layer is 10 atom % to 40 atom %, and the content of N in said Ge-containing layer is at least 40 atom %.

51. (Original) The optical information recording medium according to claim 50, wherein the Ge-containing layer is in contact with at least one surface of the phase-change recording layer.

52. (Previously presented) The optical information recording medium according to claim 50, the medium comprising a first Ge-containing layer and a second Ge-containing layer, the first Ge-containing layer and the second Ge-containing layer comprising either one selected from the group of GeXN and GeXON as a main component,

wherein X is at least one element selected from the group consisting of elements belonging to Groups IIIa, IVa, Va, VIa, VIIa, VIII, Ib and IIb and carbon,

the phase-change recording layer having a first surface on which laser beams are incident in use and a second surface on the other side,

wherein the first Ge-containing layer is in contact with the first surface and the second Ge-containing layer is in contact with the second surface.

53. (Previously presented) The optical information recording medium according to claim 52, wherein the content of X in the first Ge-containing layer is different from the content of X in the second Ge-containing layer.

54 - 55. (Cancelled)

56. (Original) The optical information recording medium according to claim 50, wherein a composition ratio of (GeX), O and N in the Ge-containing layer has numerical values which lie within the range represented by the area ABDC in a ternary phase diagram of (GeX), O and N, where the points A, B, C and D are as follows:

A $((GeX)_{90.0}O_{0.0}N_{10.0})$, B $((GeX)_{83.4}O_{13.3}N_{3.3})$,

C $((GeX)_{35.0}O_{0.0}N_{65.0})$, D $((GeX)_{31.1}O_{55.1}N_{13.8})$.

57. (Original) The optical information recording medium according to claim 56, wherein a composition ratio of Ge and X in the Ge-containing layer is represented by $Ge_{1-p}X_p$ $(0 < p \leq 0.5)$.

58. (Original) The optical information recording medium according to claim 50, wherein a thickness of the Ge-containing layer is at least 1 nm.

59. (Original) The optical information recording medium according to claim 50, wherein X is at least one element selected from the group consisting of Cr, Mo and Mn.

60. (Original) The optical information recording medium according to claim 50, wherein X is at least one element selected from the group consisting of Ti, Zr, Nb and Ta.

61. (Original) The optical information recording medium according to claim 50, wherein X is at least one element selected from the group consisting of Fe, Co and Ni.

62. (Original) The optical information recording medium according to claim 50, wherein X is at least one element selected from the group consisting of Y and La.

63. (Original) The optical information recording medium according to claim 50, wherein the phase-change recording layer comprises a phase-changeable material including any one selected from the group consisting of Te, Se and Sb as a main component.

64. (Original) The optical information recording medium according to claim 50, wherein the phase-change recording layer comprises a phase-changeable material including Te, Sb and Ge as a main component.

65 - 73. (Cancelled)

74. (Original) The optical information recording medium according to claim 51, wherein the Ge-containing layer prevents atoms from diffusing between the phase-change recording layer and a layer adjacent to the recording layer.

75. (Cancelled)

76. (Currently amended) An optical information recording medium comprising a substrate and a multilayer film, the multilayer film comprising:

a barrier layer;

a first protective layer that comprises sulfur; and

a recording layer generating a reversible phase-change which can be optically detected according to an irradiation of an energy beam;

wherein said barrier layer is formed between said first protective layer and said recording layer and in contact with said first protective layer and said recording layer, and includes GeXNO, where X is at least one element selected from the group consisting of Al, B, Ba, Bi, C,

Ca, Ce, Cr, Dy, Eu, Ga, Hf, In, K, La, Mn, Nb, Ni, Pb, Pd, Si, Sn, Ta, Ti, V, W, Yb, Zn and Zr, and

wherein the content of X to the total content of Ge and X in said barrier layer is 5 atom % to 40 atom %.

77. (Previously presented) An optical information recording medium comprising a substrate and a multilayer film, the multilayer film comprising phase-change recording layer having reversibly changeable optical characteristics and a Ge-containing layer comprising GeXON as a main component,

wherein X is at least one element selected from the group consisting of elements belonging to Groups IIIa, IVa, Va, VIa, VIIa, VIII, Ib and IIb and carbon, and

wherein the content of X to the total content of Ge and X in said Ge-containing layer is 5 atom % to 40 atom %.